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GB 2268581 A EP 0259973 A2 WO 94/17366 A1
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(71) Applicant(s)
British Aerospace Public Limited Company

(Incorporated in the United Kingdom)

PO Box 87, Corporate Intellectual Property Dept, Lancaster House, Park East, Farnborough Aerospace Centre, FARNBOROUGH, Hants, GU14 6YU, United Kingdom

Biomedica Ltd

(Incorporated in the United Kingdom)

Research House, Fraser Road, PERIVALE, Middx, UB6 7AQ, United Kingdom

(72) Inventor(s)
David Andrew Page
Dudley Finch

(74) Agent and/or Address for Service
Susan Patricia Potts
British Aerospace Public Limited Company, PO Box 87, Corporate Intellectual Property Dept, Lancaster House, Park East, Farnborough Aerospace Centre, FARNBOROUGH, Hants, GU14 6YU, United Kingdom

(54) Temperature-sensitive catheter

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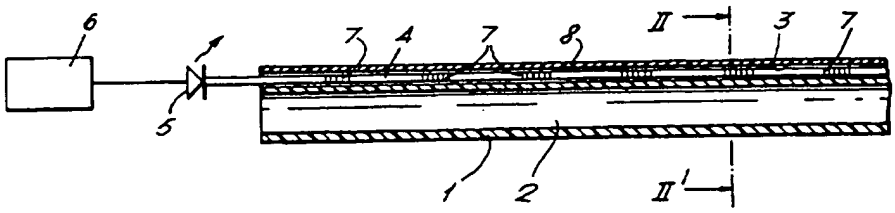
Fig.1.



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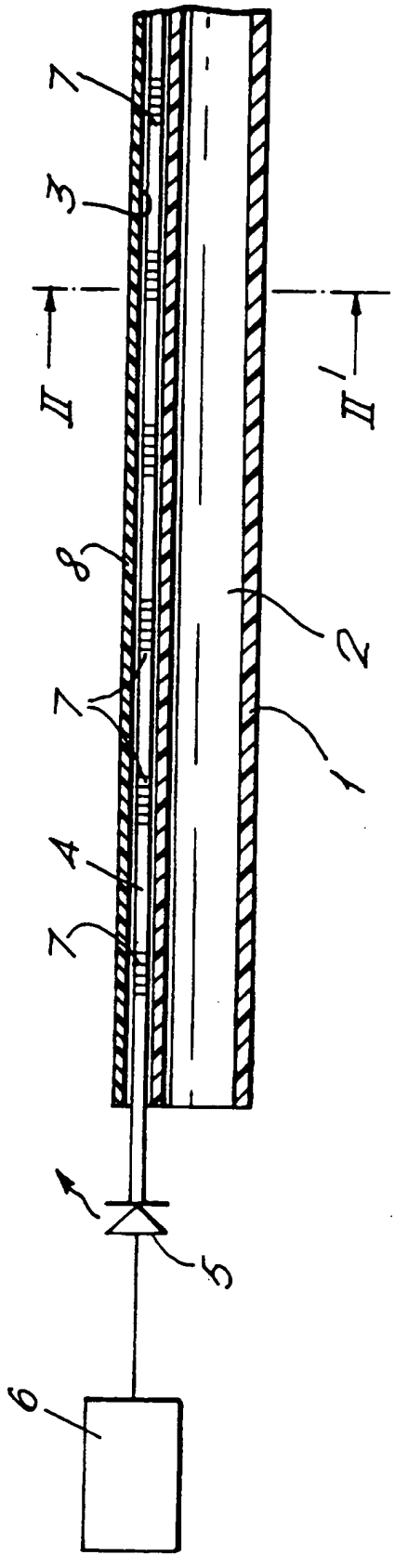

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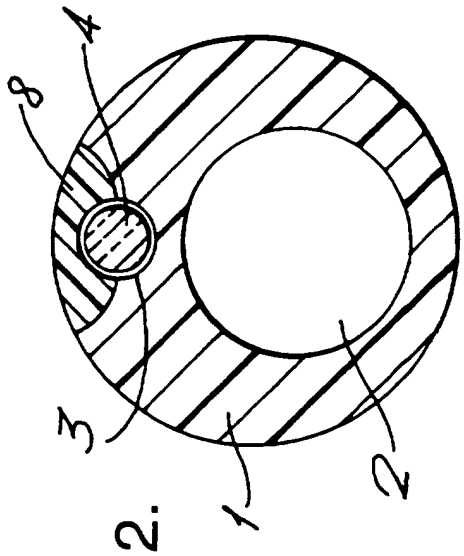

Fig.2.

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A TEMPERATURE-SENSITIVE CATHETER

This invention relates to improvements in catheters.

Catheters can be inserted into a human or animal body intravascularly in order to infuse drugs or fluids or to measure some property of the body at a particular site, e.g. blood flow rate.

There is a finite possibility of infection due to the catheter insertion, mainly at two sites:- at the tip of the catheter, and at the insertion site. Detection of infection is normally difficult in the early stages. The first indication is a temperature rise at the site of the infection. The invention can be used to measure the temperature at the tip of the catheter, at the insertion site and at several points in between, thereby giving an early indication of the onset of any infection.

According to the invention, a temperature-sensitive catheter comprises an elongate catheter body and a fibre optic cable affixed thereto wherein the fibre optic cable incorporates at least one optical grating.

The temperature measurement technique depends on the variability of the Bragg wavelength of an induced grating within a fibre optic cable. The grating can be formed by a variation in the refractive index of the fibre core written when the fibre is drawn. The Bragg wavelength of reflected light from the grating is a function of temperature and strain of th fibre at the site of the grating. In this application temperature effects will dominate and strain will b regarded as constant.

By writing several gratings into the fibre distributed along its length, the temperature can be measured at several sit s. This requires discrimination between the various sites. Because the length of fibre required is relatively short, temporal discrimination is impractical and in the preferred embodiment wavelength discrimination is used. In this case the gratings are written with different frequencies so that there is a significant change in Bragg wavelength between gratings.

Advantageously, the invention measures temperature optically, requiring no introduction of electrical conductors or electrical potentials or currents into a patient's body, thereby being electrically safe and avoiding electrical interference from external sources.

The invention covers the measurement of temperature for both short term (e.g. during clinical procedures) and long term monitoring.

The fibre optic cable may be located by means of embedding the fibre into the core of the catheter body. The catheter body could in this case typically consist of many lumens or cavities into one of which the fibre would be fed.

Alternatively the fibre may be secured at the insertion site using a stud or button which would fasten to the outside of the catheter body once it was in position intravascularly. The latter arrangement offers the advantage of lower risk to the patient should the fibre fracture or break within the catheter.

The catheter body can be made from a wide range of materials which are polymeric in origin, although any requirement to exhibit enhanced blood compatibility will limit the number of polymers that can be used. Examples with good blood compatibility include polyurethane, polyvinyl chloride and silicone.

Further advantages of the invention are; the possibility of computer interfacing for data logging, a sensitivity of 0.001k, operation which is independent of drug dose rate, minimal interference with drug delivery systems and the capability of use with small blood vessels.

An embodiment of the invention will now be described, by way of example only, with reference to the drawings of which:

Figure 1 is a sectional side view of a catheter in accordance with the invention, and

Figure 2 is a cross-sectional view along a line II-II' of Figure 1.

Referring to Figure 1, a catheter comprises an elongate catheter body 1 which incorporates a central channel 2 for the injection of fluid (drugs eg) into a patient's body. The catheter body 1 includes a further channel 3 into which is inserted a fibre optic cable 4.

The fibre optic cable 4 is connected at one of its ends to a laser diode light source 5 and measurement system 6. Gratings 7 are written into the fibre optic cable 4 at several locations along its length.

Referring now to Figure 2, the catheter body 1 is drawn from PVC and (optionally) incorporates a thermally-conducting

segment 8, which runs the length of the catheter body 1 and is located adjacent to the fibr optic cable 4 so that good thermal conductivity between the fibre 4 and the outside of the catheter but not the inside of the catheter exists.

Good conductivity between the fibre 4 and the inner walls of the catheter body would result in the temperature sensed being contaminated by the temperature of the drugs being introduced into the patient's body. This is undesirable, therefore the thermally-conducting segment 8 is confined to the peripheral region of the catheter body 1.

As a further option the segment 8 can also be made to be radio-opaque thereby permitting X-ray tracking of the catheter within the patient's body. A suitable material for the segment 8 in this example is tungsten-loaded PVC.

In use, the catheter is inserted into a patient's body as appropriate, the drug dose is administered as appropriate and the light source 5 is activated.

By monitoring the frequencies of light reflected from the individual gratings 7, the measurement system 6 is able to monitor the temperature of the surrounding patient's tissue at the insertion site and catheter tip and various points in between.

CLAIMS

1. A temperature-sensitive catheter comprising an elongate cath ter body and a fibre optic cable affixed thereto wherein the fibre optic cable incorporates at least one optical grating.

2. A temperature-sensitive catheter according to claim 1 in which said optical grating is formed by a variation in refractive index of the core of said fibre optic cable.

3. A temperature-sensitive catheter according to claim 1 or claim 2 and incorporating a plurality of gratings, each of said gratings having a different Bragg wavelength.

4. A temperature sensitive-catheter according to any preceding claim in which the catheter body includes a channel running along its length, in which is located said fibre optic cable.

5. A temperature-sensitive catheter according to any of claims 1 to 3 in which the catheter body includes securing means for fastening said fibre optic cable to the outer surface of the catheter body.

6. A temperature-sensitive catheter according to claim 4 in which the catheter body incorporates a thermally conducting segment located adjacent to said fibre optic cable and running the length of the catheter body.

7. A temperature-sensitive catheter according to claim 6 in which said thermally-conducting segment is opaque to X-rays.

8. A temperatur -sensitive cathet r according to claim 7 in which said thermally-conducting segment is composed of tungsten-loaded PVC.

9. A temperature-sensitive catheter according to any preceding claim in which the catheter body is drawn from a polymeric material.

10. A temperature-sensitive catheter substantially as hereinbefore described with reference to the drawings.

The Patent Office

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Examiner: Mr Conal Oram
Date of search: 13 February 1996

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

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Int Cl (Ed.6): A61B (5/00), G01J (5/38), G01K (11/32, 13/00), G01N (21/45)

Other: Online: WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
Y	GB 2268581 A	(GEC-MARCONI) See figure 2, page 2 lines 5-9 and page 5 lines 6-7.	1, 3 and 4
Y	EP 0259973 A2	(SHULZE) See figure 1 and abstract.	1-4
Y	WO 94/17366 A1	(UNITED TECHNOLOGIES CORPORATION) See figure 1, page 9 lines 1-5, page 10 lines 13-16 and page 10 line 30 - page 11 line 1.	1-4
Y	WO 89/11311 A1	(KASEVICH) See figure 1, abstract and page 13 line 11-16.	1-4
Y	US 4996419	(MOREY) See the figure and column 1 lines 13-40.	1, 3 and 4
Y	US 4868381	(DAVIS) See figure 2, column 1 lines 52-55 and column 2 line 52 - column 3 line 3.	1-4
Y	US 4806012	(MELTZ et al) See figure 1 and 3; and column 2 lines 17-20 and lines 62-66.	1-4

X Document indicating lack of novelty or inventive step
Y Document indicating lack of inventive step if combined with one or more other documents of same category.
& Member of the same patent family

A Document indicating technological background and/or state of the art.
P Document published on or after the declared priority date but before the filing date of this invention.
E Patent document published on or after, but with priority date earlier than, the filing date of this application.

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(74) Agent and/or Address for Service
Susan Patricia Potts
British Aerospace Public Limited Company, PO Box 87, Corporate Intellectual Property Dept, Lancaster House, Park East, Farnborough Aerospace Centre, FARNBOROUGH, Hants, GU14 6YU, United Kingdom

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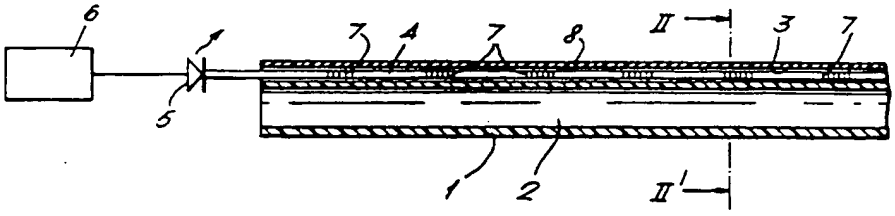

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